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APRIL 1946

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Editorial

With the restoration of the lower frequency bands in sight, it is the duty of the Wireless Institute of Australia in each State to press for establishment—in conjunction with some responsible authority—of a permanent Emergency Communications Network.

The need for such an Emergency Communications Network, has been proved recently by the disastrous floods in Victoria, Queensland, New South Wales and Tasmania, when telephone wires went out and many places were isolated.

The New South Wales Division were fortunate in establishing, during the war years, an Emergency Communications Network under the authority of the National Emergency Services, which operated in the Sydney suburban area, and laterly in conjunction with the Bush Fires Advisory Committee. Tasmania, South Australia and Western Australia were also given permission to establish such a Net during the War.

Surely the work put in by those States convinced the authorities of the value the Amateur, who in pursuit of his hobby, can be to the Community—and at no expense to the Community, too.

The Royal Australian Air Force Wireless Reserve was such an organisation, one which, at the outbreak of the war, if full credit were to be given, saved the R.A.A.F. Communications from chaos.

The Wireless Institute of Australia in each State can, and will, given the necessary authority establish Emergency Communication Networks which could cover any contingency where normal communications have failed.

IN THIS ISSUE

FREQUENCY MODULATION

By J. BROWN, VK7BJ*

PART 1—PRINCIPLES

Frequency Modulation is a topic that, to-day, is on the tongues, or should I say, in the hair of most of the population, both technical and otherwise. Many claims have been made for this system. so I am going to endeavour to outline the position as it is at the present time. Of necessity most of what follows is based on theory, and I would appreciate comments from those members who may have had practical experience of Frequency Modulation in the Services.

Despite the remarks of some of our political heads, F.M. is not likely to supplant A.M. in Australia, and its role will probably be to provide local services. As F.M. is practicable only when using UHF (40 mc or higher), this restricts the range to not much more than the visual horizon and so prevents the coverage of the vast thinly populated areas of Australia. In this respect, an interesting proposal has been made in U.S.A., to the effect that large aeroplanes flying in circles at 30,000 feet or so be equipped with powerful F.M. transmitters. These would be used to relay programmes originating from studio on the ground and, by reason of their height, would cover a very large area. Whilst the scheme is technically sound, it still remains to be seen whether it will be a commercial proposition. Probably the set-up in Australia will be a few high powered AM stations operating on clear channels in the existing Broadcasting band for national coverage, with local services provided by FM stations on channels above 100 mc/s. As the public would certainly insist on sets which could receive both types of transmission, difficulties with receiver design will crop up. The best solution appears to be the use of separate R.F. and, with a common AF end and power supply. The only extra parts of note required over a combination system would be a few valves and the receiver would be much easier to build and maintain. In any case a FM receiver, despite the dreams of some wishful thinkers, is much more complicated and expensive than the corresponding AM set.

Radio manufacturers, of course, are boosting FM as it provides them with new markets, and it is in such countries as the U.S.A., where sales saturation had just about been reached in the AM field, that FM is making its greatest headway. In fact, English engineers seem to regard it coldly, but the mixed use of FM and AM just mentioned seems very suitable for Australian conditions. As far as public demand is concerned, the High Fidelity aspect of FM seems to be over-estimated, as the average listener does not desire it. In fact, given a good receiver the usual listener complains about its shrillness and immediately applies the tone control to make it "nice and mellow." Also in Australian practice relays and recordings form a large part of the programme and, as most

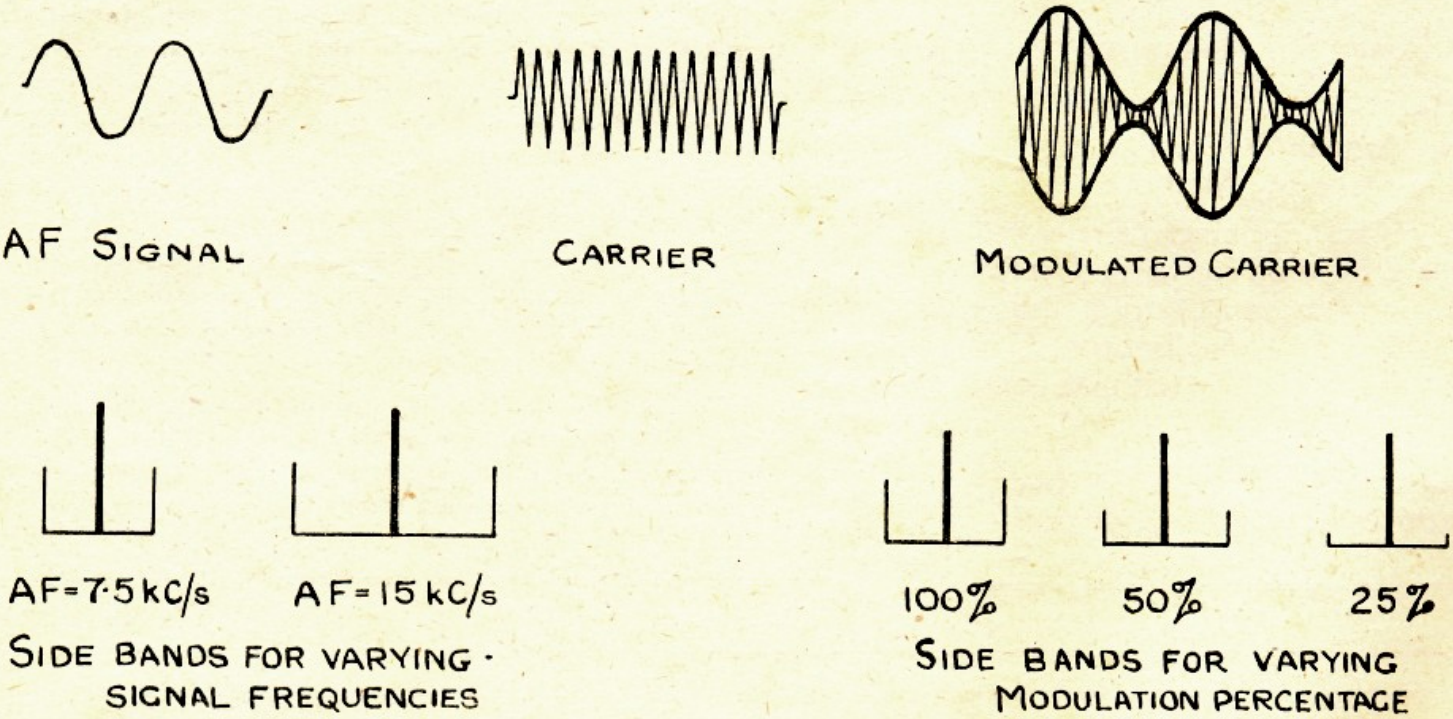


FIG 1.

AMPLITUDE MODULATION

*12 Thirza Street, Newtown, Hobart, Tasmania

Interstate relays cut off at about 7,500 c/s and commercil recordings about 5,000 c/s, there does not appear to be much advantage in the extended range to 15,000 c/s offered by FM.

Having neglected the old proverb about prophets, I now propose to deal with the features of a FM broadcasting system. Actually many Hams unknowingly had some experience of FM pre-war, even though it was unintentional. Do you remember the modulated oscillators on 5 metres where we sometimes had to tune the receiver off the carrier in order to receive the modulation properly This was caused by the fact that, in trying to modulate an unstable oscillator, actually more FM than AM was produced. In 1922, during a search for better methods of modulation, FM was investigated by J. R. Carson, but it was dropped when it was found that an enormous frequency band would be required, as this was impracticable on the low frequency band then in use. However, in 1936, Major Armstrong announced a FM system which, by reason of its location in the UHF band, was eminently practicable and it is this and allied systems which are to be dealt with.

There are three ways by which a Sine wave, such as the carrier wave of a broadcasting station, can be modulated. The first is the familiar amplitude modulation shown in Fig. 1. In this the frequency of the carrier is maintained constant and its amplitude varied in accordance with the amplitude of the modulating AF signal, and at a rate equal to its frequency. This gives rise to what is known as Sidebands which occur each side of the carrier frequency at distances equal to the AF signal frequency. Thus a 15 Kc/s signal would require a band width of 30 Kc/s for transmission. The maximum permissable variation of the carrier amplitude is from zero to twice normal value and this is called 100% modulation. Any variation less than this is also rated in %, i.e., 45%, but any increase over 100% causes the carrier to be be zero over a portion of the AF cycle, giving rise to severe distortion. This condition is known as overmodulation. At 100% modulation the power of the carrier is unchanged but the sidebands have a power equal to 50% of the carrier and, inorder to provide for this, the peak power capability of the transmitter must be 4 times its unmodulated output. In order to achieve AM it is also necessary either to run the radio-frequency amplifiers at a low efficiency (around 30%) or else to provide an amount of Audio frequency power equal to ½ the power input to the last RF amplifier. For these reasons the AM transmitter is costly both to build and to maintain.

The second method of modulation is to keep the carrier amplitude constant, but its frequency is varied in accordance with the amplitude of the AF signal. In pure frequency modulation, the variation of frequency is proportional only to the amplitude and sign of the AF signal, whilst the rate of variation equals the AF signal frequency.

In the third method the carrier amplitude is kept constant also, but its phase is varied, the variation being proportional to the AF signal's amplitude and sign, and the rate of variation equal to its frequency. The final result is similar to frequency modulation however, as varying the phase of a wave is equivalent to varying its frequency. (Take two waves of the same frequency and in phase with one another; then so long as the frequencies remain the same, the two waves must remain in phase. However, if the frequency of one of the waves changes, the phase will be continually changing giving rise to the familiar phenomenom of beats. The reverse is true, i.e., if the phase is changing there must be a corresponding difference of frequency to permit it to do so). There is one important difference between phase and frequency modulation however. In pure frequency modulation the variation of frequency depends only on the amplitude of the AF signal and is independent of its frequency, but in phase modulation the resultant frequency variation is proportional to both the amplitude and the frequency of the AF signal. This causes the variation of carrier frequency to be excessive when modulated by the higher frequencies. In practice, where phase modulation is used, the resultant modulation is made equivalent to pure frequency modulation by inserting a filter before the modulator which reduces the AF signals in proportion to their frequency. By this means as the frequency of the AF signal increases so does its amplitude decrease, thus making the carrier frequency variation the same for all AF signals. This method was that originally used by Major Armstrong.

Two terms which frequently occur in any discussion of FM are Deviation and Deviation Ratio. Deviation is the swing (in Kc/s) each side of the resting frequency, whilst Deviation Ratio (also called Modulation Index Mp.) corresponds to Modulation % in AM. However, in FM there is nothing corresponding to over-modulation and Mp. is defined as

$$\frac{\text{Deviation (Kc/s)}}{\text{AF signal frequency (Kc/s)}}$$

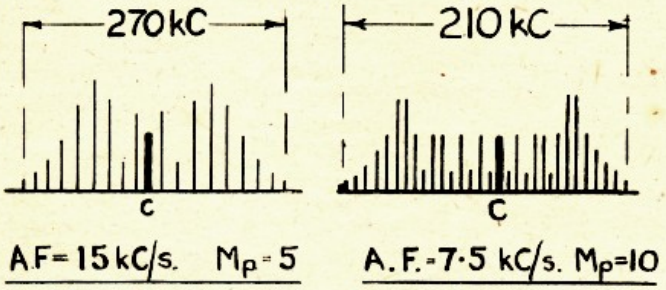
A deviation of 75 Kc/s is commonly used and AF signals from 30 to 15,000 c/s are transmitted, giving rise to Mps of from 5 at 15 Kc/s to 2,500 at 30 c/s. Because of this modulation by single AF frequencies will be considered in the following discussion. The only difference in practice when a complex AF signal is used is the greater complexity of the frequency spectrum.

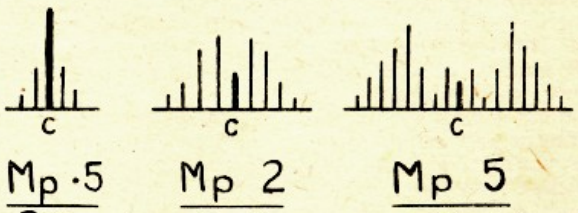
Sidebands are also produced in FM, theoretically exending from an infinite frequency on one side of the carrier to zero frequency on the other and are spaced at intervals equal to the frequency of the AF signal. This is in sharp contract to AM where there is only one pair of side bands to each AF signal frequency. In practice, however, after a number of sidebands each side of the carrier slightly greater than Mp + I the amplitude rapidly falls to zero (see Fig. 2). This gives rise to the interesting fact that the band width required for all Audio frequencies is approximately the same, e.g., at 30 c/s there are 2,501 sidebands spaced 30 c/s apart each side and at 15 Kc/s there are 6 each side spaced 15 Kc/s, both giving a bandwidth of approximately 150 Kc/s. This again contrasts with the case of AM where the bandwidth is twice the AF frequency. The total power of the FM signal does not increase as it does in the case of AM, the energy of the carrier being distributed over itself and the sidebands.

Having learnt something about the nature of FM we are now in a position to consider its pros and cons. The first outstanding feature is the wide frequency band required; 150 Kc/s for normal broadcasting. This makes the use of the UHF band necessary and so makes FM unsuited for nation-wide broadcasting, but this together with another of its features makes it very suitable for providing the very large number of channels required for local broadcasting. If there are two or more FM stations on the same channel and large deviations are used the strongest signal (providing it has at least a 2 : 1 majority) suppresses all the others and interference free reception will result. Sometimes there is a residual amount of hash due to random heterodynes and to eliminate this entirely the stronger station should be 20 Db. above the others. Thus the use of shared channels is quite practicable with FM provided the stations are separated by a moderate distance. Contrast this with the interference arising from the use of shared channels in the present AM band. However, some peculiar effects can be obtained when the stations are about the same strength and fading, the strongest station at the time will take charge and the listener may get a frequent change of programmes.

At the transmitter end FM has quite a few advantages over AM. Firstly as the carrier power does not change when modulated, highly efficient amplifiers running at full output may be used resulting in considerable savings in first cost, in subsequent maintenance, and in

power bills. As only a small amount of AF power is required for full modulation the Audio equipment is both cheap and easy to design for wide frequency response and low distortion. The modulating circuits used in FM are of considerable complexity and require a large number of valves and other parts. Whilst this is immaterial for high power broadcasters, where it is overbalanced by the larger savings above, it is a considerable drawback for the average Ham. Another advantage, although not due to FM directly, is that at the short wave lengths used very efficient radiating structures are possible at reasonable cost. On the present broadcasting band an efficient aerial may cost as much as the rest of the station.





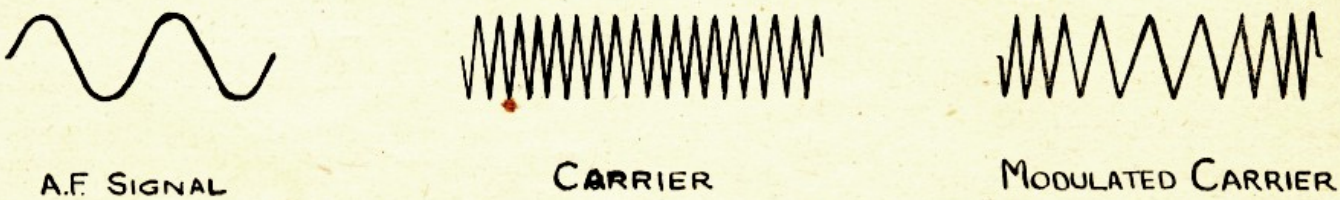


FIG 2
FREQUENCY MODULATION

The general public, however, is more interested in the advantages to be obtained at the receiving end. In order to secure the full benefit of these advantages the receiver will need to be fairly complicated and expensive, thus FM sets will never be as cheap as AM sets. The first advantage is that high fidelity can be more easily obtained when using FM. Present AM transmitters are far in advance of present AM receivers and this is mainly due to the necessarily close spacing of stations, requiring selectivity to be so high as to prevent the passing of even the 20 Kc/s band required to transmit an AF signal of 10 Kc/s. For FM wide spacing of stations can be employed owing to the space available at the UHF used, and the fact that the use of shared channels is entirely satisfactory. This together with the fact that interference from adjacent stations is very small, as a FM detector is not very responsive to frequencies outside its proper pass band, permits the selectivity to be such that the full pass band of 150 Kc/s can be accommodated. The spacing probably will be 200 Kc/s as compared with 10 Kc/s on the present broadcasting band. It should be noted that, as the deviation is proportional to the amplitude of the AF signals, the loss of the higher sidebands in FM causes amplitude distortion, not loss of the higher audio frequencies as in AM. Whilst the RF end will thus easily handle AF signals from 30 to 15,000 c/s., it is wasted unless the AF end and the loudspeaker system are also designed for this range.

It is doubtful, however, if this high fidelity would be of any use without another feature of FM, viz., reduction of noise. In the past high fidelity AM receivers have been marketed, but owing to the background of noise which is produced when the frequency response is extended the result may be rather unpleasant. Often the tone control has to be used to cut off the higher frequencies and so reduce the noise. In FM this reduction of noise is taken care of by the nature of the system itself. Most noises due to static and to man-made interference have both AM and FM components. The AM component is eliminated by the use of a limiter which chops off all peaks and signal above a certain value. The signal is then passed on to a special detector which, whilst it is very sensitive to changes of frequency is not much affected by any amplitude variations which may have escaped the limiter. The net result is that the AM component of the noise is eliminated The FM components impresses an FM modulation on the signal, but this is very small compared to the large deviation of the signal itself and so the resultant noise is small. The actual noise reduction is proportional to

$$2\frac{\text{Max Deviation (Kc/s)}}{\text{Highest Audio Frequency (KcIs)}}$$

i.e., for the usual system it is about 10 : 1. In practice much greater reductions are achieved, up to 50 Db. reduction has been claimed. For a useful reduction to be accomplished the signal strength must be above a certain limiting value, known as the Threshold value and, if it is not, no reduction in noise may be achieved. In fact the noise may even suppress the signal. For Amateur work, where it is only necessary to transmit up to 5,000 c/s at the most, a deviation of 25 Kc/s would be adequate to reduce noise, but if the deviatlion is less than this the noise reduction would also be less. Very narrow band FM is sometimes used for long distance work for which wide band FM is not very suitable owing to the loss of essential sidebands due to selective fading. In

(Continued on Page 22)

PLASTICS FOR THE AMATEUR

By A. G. CHAMBERS, M.I.R.E., A.M. (Brit.) I.R.E. (G5NO)

This article has been taken from the R.S.G.B. Bulletin for the information of the Ham and others interested in the subject of plastic insulating materials. Many of the materials mentioned herein are under their British trade names, and it is possible that they are or will be marketed in his country under a different name. However, the information should prove of much value to the reader.

During the past five or six years, considerable progress has been made in the comparatively new science of plastics and the radio and electrical industries have been those mainly responsible for its development. Thermo-setting plastics are used extensively nowadays for many kinds of electrical fittings, such as switches, sockets, electric irons and hairdryers, clocks and radio cabinets.

The discovery of the new plastic materials was no accident. The chemists knew what they wanted, and continued their experiments until the desired result was obtained. Plastics are known to have been in existence many years ago. The Egyptians used a form of plastics, but Bakeland, in the latter half of the last century, was responsible for the discovery of the first modern plastic, the material now known as Bakelite being the result. Only recently, however, have intensive experiments been carried out with the bi-products of calcium carbide (the well known chemical used for lighting old fashioned bicycle lamps) which, after a number of complicated chemical reactions resolves itself into the new thermo-plastic materials which are now on the market. It is these new materials in which we are chiefly interested, since they possess excellent high frequency properties. The older plastics have been included in the data for the sake of completeness.

A large number of books have been written on the subject, but unfortunately some knowledge of chemistry is necessary for them to be understood; the object of this article, therefore, is to give to the amateur, in simple language, all the information he will require to know, without going into chemical details. The writer is "an amateur like yourself" and no chemist, with the exception that he has been fortunate in being able to compile information which, it is hoped, will be helpful when planning the post-war transmitter, or repairing some pre-war component extracted from the proverbial junk box.

CLASSES OF PLASTICS

Plastics are divided into two classes, namely, those which are Thermo-setting, and those which are Thermo-plastic. Thermo-setting plastics are of the hard brittle variety such as Bakelite, Paxolin, Beetle, Tufnol and Panilax. Ts the name implies, once heat has been applied (that is during moulding processes), they set. Any further applications of heat, either changes them immediately into a liquid form, or else they burn. Strictly speaking, they are not plastics.

Thermo-plastics such as Perspex, Alkathene, Distrene, etc., however, can be re-heated, formed into new shapes, and when cold will retain their new shapes. If heated beyond the plastic state they turn into liquid, but again, on cooling, they pass through the plastic state before finally hardening.

Naturally, according to which class they belong, plastics are used where they are best suited. For example, it would be useless having a radio cabinet which, when placed near the drawingroom fire wilted when it became warm! Alternatively, a cable which cannot be bent is of little value.

Unfortunately, plastics are known under many and varied trade names. The writer counted thirty-eight, but ther are many more; while in actual fact he is aware of only fifteen basic compositions.

THERMO-SETTING RESINS

Now let us take them in order, commencing with the Thermo-setting resins.

Phenol—Formaldehyde Cresol—Formaldehyde.

(Trade names: Bakelite, Catalin, Elo, Epok, Mouldrite, Nestorite, Paxolin and Rockite).

Chiefly used for moulding. Brownish opaque material, which can be machined. It is insoluble, therefore cements of the solvent type, such as are used for Thermo-plastics, cannot be used. Bakelite cement, an accelerator, Q.11117, making it set at atmospheric G.11116, is a "cold setting" cement which is used with temperature. At 20 degrees C. joints should be clamped for twelve hours, after which they will not come apart; but the article should be left for five or six days to harden.

Specific gravity	1.28-1.52
Tensile strength	6,000-10,000 lbs./sq. in.
Maximum temperature for continuous Resistance to heat	250 degrees F.
Water absorption (Immersed for 24 hours)	1.2%
Burning rate	Very low
Dielectric constant at 1 Mc/s	7.3
Power factor at 1 Mc/s	0.24
Breakdown voltage (⅛ in. specimen)	300-500 volts/mil
Hardness (Brinell)	30-45

Uses—Has many well known uses which are too numerous to list.

Urea Formaldehyde.

(Trade names: Beetle and Mouldrite).

Chiefly used for moulding; basic colour is white, but opaque, and like Bakelite, can be machined. It is insoluble but can be cemented by Beetle Cement E, with hardening powder A at 40 degrees C. It can be identified by heating in a flame, whence a strong smell of Formaldehyde and Ammonia comes off. The material chars but it non-inflammable.

Specific gravity	1.45-1.50
Tensile strength	9,000-12,000 lbs./sq. in.
Maximum temperature, etc.	160 degrees F.
Water absorption, etc.	1.2%
Burning rate	Very low
Dielectric constant at 1 Mc/s	7.7
Power factor at 1 Mc/s	0.036-0.039
Breakdown voltage (⅛ in. specimen)	600-700 volts/mil
Hardness (Brinell)	48-54

Uses—Control knobs, coloured panels and radio cabinets.

Phenol—Cresol—Urea and Aniline Formaldehyde.

(Trade names: Tufnol, Panilax, Delaron, Fraffolite, Micarta).

Available in sheets, composed of alternate layers of paper and soluble resin which makes it very strong (note the higher tensile strength). Is yellow or brown in appearance and is also available in rods and tubes. It possesses excellent electrical properties with small water absorption. It can be machined in the same manner as bakelite and may be cemented by Ardux. The joint must be heated after application to at least 140 degrees C., and sets in 5 to 10 minutes. A useful cement is made by mixing one part Resorcinol with one part Paraformaldehyde and two parts Methylated Spirit. This mixture sets at 100 degrees C.

Specific gravity 1.30-1.40
Tensile strength ..... 10,000-20,0000 lbs./sq. in.
Maximum temperature, etc. ..... 250 degrees F.
Water absorption, etc. 0.3-0.9%
Burning rate ..... Very low
Dielectric constant at 1 Mc/s 6.0
Power factor at 1 Mc/s 0.03
Breakdown voltage ..... 400-600 volts/mil
Hardness (Brinell) 24-50
Uses—Instrument panels. Where installation is required in the open air this material is excellent, as it shows little shrinkage on prolonged exposure to climatic conditions.

THERMO-PLASTIC RESINS.

We can now turn to the more modern, and as far as the amateur is concerned, the more interesting, Thermo-plastic resins.

Methyl Methacrylate.

(Trade names: Perspex (I.C.I. Ltd.); Diakon, Lucite, Transpex (I.C.I. Ltd.); and Kallodent (I.C.I. Ltd.).

Available in powder, sheet, rod, tube or liquid. It is a water-white transparent plastic with a high refractive index, and is thus often used to replace glass. Resistance to weathering and extremes of temperature is another excellent property. Being thermo-plastic it can be shaped easily at 130 degrees C. retaining its new shape upon cooling. Can be identified by heating in a test tube. It does not melt or char, but decomposes and a liquid distils off. Material can be machined, moulded or shaped. The liquid gives clear castings, an example of which is an aerial insulator made by I.C.I. Plastics.

Unplasticised "Perspex" is harder and has a slightly greater tensile and sheer strength than platicised material, but is slightly less resistant to impact.

At low temperatures the tensile strength and modulus of elactisity of "Perspex" increase, whilst the impact strength remains the same (i.e. the material does not become brittle) down to temperatures of the order of minus 40 degrees C.

There are two cements for "Perspex," namely "Diakon' Cement No. 2 and "Perspex" Cement No. 6. As both are liable to become very viscous when exposed to the air, they should be kept in containers with well-fitted stoppers.

"Diakon" Cement No. 2 is a quick-hardening cement suitable for cementing "Perspex" to "Perspex" when the area of contact is relatively small. Joints made with this cement should be left undisturbed for about an hour, after which they will be sufficiently set to withstand handling.

"Perspex" Cement No. 6 is a slow hardening cement and its use is recommended for cementing "Perspex" to "Perspex" when the area of contact is large. Joints made with this cement should not be disturbed for about three hours after cementing.

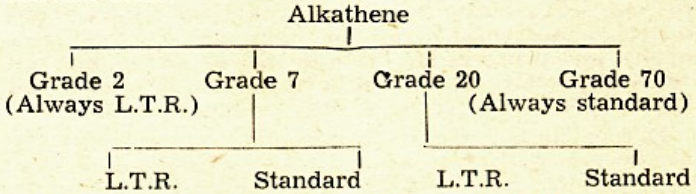
Specific gravity 1.18
Tensile strength ..... 7,000-9,000 lbs./sq. in.
Maximum temperature, etc. ..... 140-160 degrees F.
Water absorption, etc. 0.4%
Burning rate ..... Very slow
Dielectric constant at 5 x 10^7 c/s 2.8
Power factor at 5 x 10^7 c/s 0.02
Breakdown (⅛ in. specimen) ..... 390 volts/mil
Softens at ..... 60-70 degrees C.
Refractive index (Transpex 1) 1,4900
Hardness (Brinell) 18-20
Uses—Has many uses. Opticians now use this material successfully for making unbreakable lenses. Dentists use the powder for moulding false teeth and dentures. Aircraft factories use it for gun turrets; in general is is replacing glass. The amateur will no doubt devise many other uses.

Polyethylene (Polyisobutylene, polythene).

(Trade names: Alkathene (I.C.I. Ltd.) and Polybutine).

Available in powder, sheet, rod, tube and film. It a wax-white translucent material, which can be moulded, machined or shaped. Is tough, strong or extremely flexible, according to grade, and has a low specific gravity. It resists all solvents when cold. At 60 to 70 degrees C. it dissolves in benzene, carbon tetrachloride, turpentine and medicinal paraffin.

Alkathene, made by I.C.I. Ltd. is available in a number of grades according to viscosity, which can be summarised thus:—



Material which is not brittle at minus 25 degrees C. is sold as "Low Temperature Resistant" (L.T.R.), whilst that which breaks at minus 25 degrees C., but not at 0 degrees C. is known as "Standard." In general the lower grade number the harder the material, and the harder the grade the lower the temperature at which it becomes brittle.

Polythene tapes are also available for repairs of H.F. Cables.

Specific gravity 0.95
Tensile strength ..... 2,000 lbs./sq. in.
Maximum temperature, etc. ..... 180 degrees F.
Water absorption, etc ..... Nil
Burning rate ..... Slow
Power factor at 5 x 10^7 c/s 0.0003
Dielectric constant at 5 x 10^7 c/s 2.3
Breakdown voltage (after 10 minutes measured on a 0.020 specimen at 50 c/s ..... 1,000 volts/mil
Instantaneous breakdown ..... 50% higher
Effect of Ozone ..... Very slight
Softens at ..... 110 degrees C.
Hardness (Brinell) 1.0-2.0
Uses—Solid insulated and air-spaced H.F. Cables, where power loss must be small. "Telcothene" available in this country is a good example of low impedance cable using polythene as a solid dielectric. Other applications include moulded parts, such as cable ends, high voltage bushings, and condenser dielectrics. Its ease in working lends itself admirably to the home constructor.

N.B.—It is actually incorrect to couple together under the same classification Athathene and Polysobtylene (P.I.B.) as actually they are quite different although some properties and uses are very similar.

Polyvinal Chloride and Copolymers.

Trade names: Welvic Chlorovene, tenatube).

Is a basic powder which when highly placistised forms a rubber like material used for the outer covering of H.F. Cables. It is also available in thin sheets. It has excellent chemical resistance and is only slightly affected by water, and will withstand difficult atmospheric conditions. The thin sheets can be slit and wound into rolls of any width for insulation and other purposes. Identification: when heated in a test tube, it browns immediately, turns black with little melting, giving off hydrogen chloride. Solvents are Methylene Chloride and chlorbenzene.

Specific gravity 1.2-1.6
Tensile strength ..... 1,000-9,000 lbs./sq. in.
Maximum temperature, etc. ..... 150 degrees F.
Water absorption, etc. 0.2%
Burning rate ..... Nil
Dielectric constant at 1 Mc/s 4-3
Power factor at 1 Mc/s 4-3
Breakdown (⅛ in. specimen) ..... 400-2,000 volts/mil
Hardness ..... 2-50 depending on type of material
Uses—Used for outer cable sheathing, and when made in the form of systoflex is known as "Tenatube."

Polystrene.

(Trade names: Distrene (B.X. Plastics), Transpex (I.C.I. Ltd.).

A hard transparent ,water-white material having a characteristic tinkle when lightly struck. Available in powder, rod, sheet, tube or liquid, which can be moulded, shaped, or machined. (Transpex 2 is only available in sheets). It has a very low power factor and dielectric constant, together with a very high resistivity, all of which remain fairly constant over a wide range of frequency. It is normally brittle, but when cold drawn changes to a tough product with unimpaired H.F. electrical properties. Its density is low and the material shows great resistance to acids. In liquid form it is used for casting. Identification: When heated in a test tube it melts to a clear liquid which boils with slight discolouration and he characerisic smell of monomer comes off. Solvents: Benzine, carbon tetrachloride and others. It is of interest to note that its power facor and dielecric constant is even better than quartz, steatite or mica.

Specific gravity 1.05-1.07
Tensile strength ..... 5,500-8,500 lbs./sq. in.
Maximum temperature, etc. ..... 140 degrees F.
Water absorption, etc. ..... Nil
Burning rate ..... Slow
Dielectric constant at 5 x 10^7 c/s 2.6
Power factor at 5 x 10^7 c/s 0.0003
Breakdown (⅛ in specimen) ..... 500 volts/mil
Softens at ..... 70 degrees C.
Refractive index (Transpex 2) 1.5900
Hardness (Brinell) 20-30

Uses—Used extensively in the making of low-loss coil formers. Available in lacquer form which is an H.F. Varnish with outstanding electrical properties. Also used for numerous H.F. insulated supports. In general is a stronger material than polythene but slightly more difficult to work.

Cellulose Nitrate (Celluloid).

(Trade name: Xylonite).

Available in rods or tubes in any colour from transparent to opaque and can be cast in the form of film (well known as "Cine-film"). It is suitable for compression or injection moulding from powder. It is easy to ignite and burns rapidly. Solvents are many, such as Acetone, Amyl Acetate, Ether Alcohol.

Specific gravity 1.35-1.60
Tensile strength ..... 5,000-10,000 lbs./sq. in.
Maximum temperature, etc. ..... 140 degrees F.
Water absorption, etc. 1-3%
Burning rate ..... Very high
Dielectric constant at 1 Mc/s 6.5
Power factor at 1 Mc/s 0.06
Breakdown (⅛ in. specimen) 300-700
Hardness (Brinell) 8-11

Uses—Well known.

Cellulose Acetate.

(Trade names: Erinofort, Celastoid, Bexoid and Cellmold).

Resembles Cellulose Nitrate but is non-inflammable. It can be both compression and injection moulded. Identification: When heated in a flame it melts and chars, giving off a strong smell of cellulose and acetic acid. Solvents are many ,such as Acetone and Benzine.

Specific gravity 1.27-1.80
Tensile strength ..... 3,000-5,000 lbs./sq. in.
Maximum temperature, etc. ..... 140-180 degrees F.
Water absorption, etc. 1.5-3.0%
Burning rate ..... Slow
Dielectric constant at 1 Mc/s 3.2-6.2
Power factor at 1 Mc/s 0.01-0.05
Breakdown (⅛ in. specimen) ..... 250-800 volts/mil
Hardness (Brinell) 8-15

Uses—Photographic film, recording discs.

Ethyl-Cellulose.

(Trade name: Ethyl Cellulose Plastic).

Similar to cellulose acetate, is tougher and is outstanding for its resistance to very low temperature. Identification: When heated in a flame it chars, and readily melts with a smell of burning cellulose. Solvents: benxine, methyl acetate.

Specific gravity 1.10-1.20
Tensile strength ..... 4,000-8,000 lbs./sq. in.
Maximum temperature, etc. ..... 140-180 degrees F.
Water absorption, etc. 1.5-2.5%
Burning rate ..... Slow
Dielectric constant at 1 Mc/s 2.0
Power factor at 1 Mc/s 0.0135
Breakdown (⅛ in. specimen) 400-750
Hardness 5-10

Uses—Often used for insulating sleeving.

THERMO-SETTING PLASTIC MATERIALS.

——(BAKELITE, PAXOLIN AND TUFNOL)

For the Thermo-setting plastics, the makers recommend that special tungsten carbide-tipped tools should be used, although this is not essential. Drill speeds should be about 1,700 r.p.m.; the included angle of "twist" slow, with wide flutes, and the cutting edges well "back off." For lathe work, a clearance angle of 12 degrees with a top rake of 25 degrees and a speed of 200 ft./min. is suggested for bakelite and paxolin, while for laminated materials, such as Tufnol, a clearance of 10 degrees degrees is recommended.

Thermo setting plastics cannot be welded, but a number of synthetic resin adhesives are available. These adhesives are primarily intended for bonding wood in the manufacture of ply-wood, furniture and decorative veneers, but other uses, such as bookbinding have been developed.

For applications where the surfaces do not afford good physical contact over their whole area, "Mouldrite" Gap-filling Cement is recommended. Other glues, based on aqueous thermo-setting resins prepared by the partial condensation of urea or phenolic materials with formaldhyde are supplied under the trade names of "Mouldrite,' U.F. Syrup 232, U.S. Syrup 235, Phenolic Glue 500 and Cresylic Glue 500/C. The action of Glueing is to bring the chemical reaction of the resin to completion by adding a specific amount of a hardening agent, by heating the resin, or by combination of both methods. The resin sets to a hard infusible solid, resistant to water and many chemical s,and so forms a strong, durable joint between the glued surfaces.

THERMO PLASTIC MATERIALS.

(PERSPEX, DISTRENE OR ALKATHENE)

Thermo-Plastics soften sufficiently for bending in boiling water. Drilling can be done cold with any type of drill. When turning tough thermo-plastic materials, a speed of 800 r.p.m. is advised, with an angle clearance of about 5 degrees. For celluloid this angle should be increased to about 30 degrees.

When working any thermo-plastic, water should be used freely on the cutting tool to keep down heat generated. Thin plastic materials can be cut like glass by scoring a line with a sharp knife, the sheet breaking easily along the line when the material is bent. Surfaces can be repolished by buffing, using pumice first, followed by buffing soap.

It is interesting to note that Polyvinal Chloride can be welded by using a jet of hot air in place of the usual welder's flame, or by clamping together and applying heat to the metal clamp. This system of welding might also be applied to other thermo-plastic materials such as "Perspex," "Distrene," and "Alkathene," although the latter can be worked by application of a soldering iron.

As the Amateur will be particularly interested in the thermo-plastic materials, due to their excellent electrical properties, information supplied by the manufacturers follows.

PERSPEX

"Perspex" or Methacrylate, manufactured by I.C.I. (Plastics) is supplied in sheets protected by paper stuck to the surface with gelatine. This paper should be left on, until all cutting and drilling is finished; after which it may be removed by easing one edge and pulling gently. The small remaining patches should be removed by washing in warm soapy water and wiped dry with cotton wool. The article should then be dipped completely in clean, cold water and left to dry.

"Perspex" can be cut by a high speed band-saw or failing this, an ordinary wood saw with fairly fine teeth and preferably having little "set." Water should be used as lubricant. The risk of cracking can be lessened if the material is first slightly warmed all over, local heating being avoided. The best means of accomplishing this is to immerse the material in water which has been heated previously to about 80 degrees C.; alternatively, it may be placed in an oven.

Drilling can be accomplished in the ordinary way, but the drills should be ground rather flat, to prevent cracking when the drill emerges from the other side. If the drill is ground so that the point is slightly off-centre, the resulting hole will be larger, but less binding results, which helps when drilling deep holes. The manufacturers recommend paraffin or water containing soluble oil as lubricant.

For hand-turning, standard wood-working tools with flat tops and ground to an angle of 55 degrees are suitable, and for slide rest turning a similar type of tool should be used, set at an angle of 60 dgrees with the spindle. A cutting speed of 65 ft./min. and a feed of 0.010 in. per revolution is advised.

"Perspex" can be shaped by heating to approximately 110-120 degrees in an oven ,an manipulated by hand or pressed into moulds. Moulds can be made of wood; if, however, iron is used, it should be heated to about 40 degrees C. first, otherwise it will chill the material. It is interesting to note in passing, that "Perspex" may be blown like glass, only the heat required is naturally very much less.

Prepared cements are now available and sold under the trade names of "Diakon Cement No. 2" and "Perspex Cement No. 6." The former is quick drying, requiring only three hours. Home-made cements can be made by dissolving flaked "Perspex" sheet in Amyl-acetate, but this is not as good as the manufactured article.

DISTRENE.

"Distrene" (or Polystrene) is slightly more difficult to work, but can be readily machined, milled and turned, provided that certain precautions are observed in methods and selection of materials.

"Distrene" softens at 70-80 degrees C. and it is therefore of the utmost importance to keep the material as cold as possible during working. In all machining and cutting operations a plentiful supply of cooling lubricating liquid must be available. A satisfactory solution is soluble oil diluted with about 20 parts of water.

Standard milling machines and cutters can be used, speeds up to 800 r.p.m. being employed. It will be found that materials vary somewhat in softness and the tool has to be varied accordingly. The top rake should be from 10-15 degrees and the side rake about 20 degrees increasing with softness. The clearance is from 5 to 10. If the material is rather soft and shows feed marks, this can be overcome by using a tool with a small radius at

Continued on Page 23

IN REVIEW

TECHNICAL BOOKS - - - - - - - RECORDINGS - - - - - - - - - - - - PRODUCTS

BOOKS

ELECTRONICS DICTIONARY—Nelson M. Cooke and John Markus.

President of the U.S.A., Andrew Jackson once said, on being ribbed about the variable nature of his own peculiar ideas on spelling: "Well, sir, its a damned poor mind that cannot think of more than one way to spell a word." The Bard of Avon, too, was noted for his originality in this direction, but that was before the days of dictionaries; nowadays, the vogue of correct spelling has almost assumed the importance of an Eleventh Commandment.

The book under review is a collection of nearly 6500 terms used in radio, television, industrial electronics, communications, facsimile, sound recording and other branches of the ever expanding electronic art.

Many of the definitions are accompanied by diagrams, such as that illustrating the natural form of a quartz crystal and showing the positions relative to the crystals axes of no less than 23 different cuts.

Some o fthe definitions are rather surprising, there is for instance, dog house, which, believe it or not, is the structure known to most broadcast station engineers in this country as the tuning hut, a small enclosure containing the antenna tuning equipment. And how many know what a "gobo" is According to Cooke and Marcus it is either a dark board used to shield a television camera lens from bright lights or an acoustic shield for a microphone to blanket sounds arriving from an unwanted direction As for such things as "idometers" and "pallesthesiombeters," not to mention "pancake tuners," I leave it to both my readers to buy a copy of this most interesting volume and find out for themselves.

The goal of the authors was to present the language of electronics in such a manner that the definitions would be of value to those who need an electronics dictionary —an dthey have succeeded, largely due to their wisdom in keeping the work to the characterd of a dictionary rather than an encyclopoedia. There is one thing they have omitted which would have been useful, and that is the pronounciation of certain of the less common terms, such as proper names. Altogether quite a useful book, even if you don't care for short stories.

Electronics Dictionary—Nelson M. Cooke and John Markus (McGraw-Hill, N.Y. 1945) 433 p. 9 x 6, over 600 diagrams, cloth bound, 35/-.

Our copy by courtesy of the Technical Book and Magazine Co.

TELEVISION TO-DAY AND TO-MORROW—Lee de Forest.

This is a truly remarkable book. The title is the sort of thing one would expect to see gracing the cover of a book intended purely for the BCL. And one would be right, yet wrong. Dr. De Forest says in his opening chapter, "Primarily this book is for the lay reader. But, in this forty-fifth year of the twentieth century, thanks largely to the interest in things scientific which radio has awakened, the average intelligent citizen is able to understand . . . such matters of science and technology as television is made of."

From the opening chapters on the general nature and the history of Television through the explanations of the technicalities of transmission and reception to the closing chapter on the future of Television, not a suspicion of mathematics disturbs the progress of the reader. Yet in the space of 120 odd pages he has been introduced quite gently to multivibrators, iconoscopes, vhf plumbing and a host of other things connected with the subject. This requires many and well-chosen words and Dr. De Forest has supplied them.

Although written in the U.S.A. the edition locally obtainable is printed in England and apparently edited there too for there is a foreword—"The American text of this book has been Anglicised as much as, but no more than, seemed necessary to ensure understanding by English readers. The word 'tube,' used sometimes to denote what we know as a valve an dsometimes what we know as a tube—e.g., cathode ray and vacuum tube—has been left as originally written—Ed."

Circuit diagrams are still right way up, though.

Television To-day and To-morrow—Lee De Forest (Hutchinson, London, 1945) 171 p. 9 x 6, index and numerous diagrams, cloth bound, 27/-.

Our copy by courtesy of Technical Book and Magazine Co.

ELECTRON TUBE DEVELOPMENTS

Special valves have been developed for carrier-system long-distance telephones, which have a high tranconductance, low input and output capicatance, and long life with low filament consumption. For radio telephone systems they have a small transit time, duplicate anode and grid leads, and short electrode leads. Thyratrons, with a mixture of mercury vapour and a rare gas, are used in regulated rectifiers for battery chargers. Cold cathode gas-filled valves giving many years of trouble-free service find many applications in telephone systems.

CORRESPONDENCE

Correspondents are requested to keep their letters short and to the point.. The Editor reserves the right to delete anything he may think fit. The views expressed by correspondents are not necessarily those of the proprietors.

Sydney.

Editor "Amateur Radio,"

I have to hand to-day a letter from Wing Commander Maurice Brown (old VK2OR) now stationed in England. He tells me has just received a G ham ticket and is operating as G2YP on 28005 Kcs. and is very anxious to contact any VK's, especially VK2's.

Main operating times are 1400 hrs. to 1700 hrs. G.M.T. on Saturdays and Sundays.

He would appreciate it if you could put a short note in the next issue of "Amateur Radio" to this effect, and so spread the news.

Thanks and B/s.,

BRUCE GLASSOP, VK2BG.

Perth,
16th March, 1946.

The Editor "Amateur Radio,"

Dear Sir,

In connection with your comments in "A.R." on a circular issued on Transix letterhead, we should be pleased if you would insert the following:—

Transix was an organisation of licensed experimenters only, whose membership exceeded the number of licensed experimenters in all other amateur bodies in this State combined.

You will, therefore, concede that there should be no fears as to the bona fides of the circular.

The Western Australian division of the W.I.A. has recently amended its constitution to provide for licensed experimenters only, and many of our members will be joining the local division ,and will plug for the ideals for which Transix stood.

Yours faithfully,
6MU, 6LJ, 6BC, 6AG, 6MN, PPK. 6SA President
TRANSIX (in recess indefinitely)

THE HIGH FREQUENCY END OF 28 MEGS.

There has been some discussion lately about the phone CW angle on the 28 Mc band. From the current issue (February) of QST the following extract may tend to spread transmissions from the low frequency end.

"Have you noticed the scarcity of stations in the HF end of the 28 Mc Band? When the band is open, we observe a concentration of 'phone around the middle portion, with decreasing occupancy either side. On the LF end. the cw gang hold forth. But only occasionally is anyone. 'phone or cw, heard in the no-man's land on the end. It will take a comparatively few hardy souls to start the ball rolling. For most effective utilisation of the band and most efficient operating we should spread out through the entire band. Come on, you fellows with the pioneer spirit, let's do something about it."

FEDERAL HEADQUARTERS

CONVENTION.—Arrangements for the all-important 1946 Federal Convention have advanced a step further with the issue of the Convention Agenda, comprising 67 items, some of which will probably meet with unanimous approval ,and many which will undoubtedly cause considerable discussion at the next Divisional Meetings and later at the Convention. Getting out the Agenda was a big job, and your Fed. Sec. is somewhat of a wreck at the time of writing these notes—so if the notes this month are screwier than usual, you know why. (If they catch the press—Ed.). (Now, is that kind?—Fed. Sec.)

There is just one thing more worrying us about this Convention business now—and that is the possibility that some Divisions may have to rely on proxies. This forthcoming Convention is probably one of the most important events in the history of Amateur Radio in this country—it certainly will be the most important Federal Convention yet held—and every possible effort should be made therefore to have a truly representative gathering.

And while we are on the subject of delegates, we would like to suggest that each Division should, after instructing its delegate on the line he is to take on the various items, give him as much power of discretion as possible. In setting out the Agenda this year we have included explanatory notes which we asked the Divisions to submit with their items, these should help, but some degree of misrepresentation of the intention behind some of the items is bound to occur no matter what precautions are taken against it, hence the need for allowing your delegate to use his common sense when recording his vote. Also we suggest it would facilitate your delegate's task if he knows wher he can quickly contact the Divisional President, Secretary or some other officer should the need arise. Telephone facilities will be available to all delegates at the Convention, and with the cooperation of the lassies on Trunk Lines, it will be possible for any delegate to confer with his colleagues at at home should a knotty point require it.

F.M. AND ALL THAT.—Federal Headquarters, pursuing its customary policy of looking after your interests, recently made application to the P.M.G.'s Department on your behalf for the release of F.M., Television, Facsimile and Pulse Transmission privileges. We have been informed in reply to this application that the matter has been considered and that it was deemed unwise to release these privileges until our other bands were released, thus relieving the mounting congestion now prevalent on the V.H.F. bands. . We believe that this is for the most part reasonable, but not applicable to F.M. We have, therefore, made a second application in respect of F.M., asking for permission to use it on all Amateur bands above 50 Mc/s, this to be reviewed later with a view to its possible use on the 28 Mc/s band, in line with American practice. Our second proposal is now under consideration.

FREQUENCIES.—Also under consideration is an application for the immediate release of the 3.5, 7.0 and 14 Mc/s bands. Rumour has it—well, many things just at present, but all we can say is that developments are expected very soon, perhaps this note will be stale before you read it. If so—don't.

HAM SPIRIT.—We were pleased to read in the VK4 notes in the last issue of "A.R." news of one of those gestures which do much to foster the Ham spirit and to make Amateur radio the fine thing that it is. We refer to the proposal by some of the members of the VK4 Division to build a station for one of their number, Arthur Tonge, who has suffered the misfortune of almost total blindness from war injuries. To the VK4 boys "we dips our lid," and to Arthur we offer the wish that this rig will bring him many happy hours. 73 OM es vy mny QSO.

FAREWELL AND THANKS

The February issue of "Amateur Radio" was the last edition of "Hams on Service" better known in the roneod magazine as "Slouch Hats and Forage Caps."

This feature was first included in the Magazine in November, 1941, and ran continuously until February, 1946, a total of four years and three months.

On many occasions the writer of the feature refused to take any credit for the effort, claiming that he only compiled the noes from letters received, and news told to him. Little did readers realise that on many (a good many too) occasions the pages were compiled and padded out from news which if published as it was, would only fill a fraction of the space it finally did.

The feature we have reason to believe was one of the most widely read ones of the magazine. The only reason for its discontinuance was due to the fact that demobilisation had so depleted correspondents to the page that finally there was not news from which to write the notes

To the person responsible for this magnificent effort, Jim Corbin, VK2YC, the Magazine Committee, on behalf of all Amateurs in Australia offer their sincerest thanks.

EDITOR.

FAST WORK

"Had a couple of souvenired Jerry u.h.f. receiving valves, and asked G6CL to put on a par in his "Bulletin." This appeared in November edition under heading "Can You Help?" and before my copy came to hand the airmail replies began arriving. Here is the list:—

British Control Commission, Hamburg—scared at first to open this one in case—contained data sheet in German.

F3XY, PAQZ, OZ4K, G2DU, G2UJ, GM8MQ.

Three BRS with B.A.O.R., Hamburg.

Four B.R.S. in England.

They all mention the valves are good to 200 mc/s. so perhaps the 10 metre restrictions at lowest frequency won't be such a drag after all!

★

During the war some very small capacitors were made using Lectrofilm, a synthetic dielectrical material developed during the war and used in applications for which only mica was previously considered suitable. These capacitors became known as "matchsticks" and will have many post-war applications in lightweight or compact equipment.

A new magnetic material known as Alnico V is two and a half times more powerful than the best available pre-war magnetic material. It makes possible lighter and more sensitive loudspeakers.

★

A new type of mixer potentiometer has been developed, consisting of five plug-in units of two mixer controls each. The mixer potentiometer controls move linearly, in parallel grooves, so that all ten can be handled simultaneously by one operator. Incoming channels attenuated as desired (over a range of 6-105 db) by the potentiometers are combined by special transformers in groups of four into an output having the same impedance as each (200 ohms). The potentiometeers are continuously wire wound, and themselves have approximately constant input and output impedances at 200 ohms. Internal cross talk between channels is less than —110 db.

DIVISIONAL NOTES

NEW SOUTH WALES

Secretary: C. S. Higins, VK2LO,
Box 1734 JJ G.P.O., Sydney.
Meeting Place: Science House, Gloucester and Essex Streets.
Meeting Night: Fourth Friday of each month.

The February General Meeting of the Division was held at Science House, Gloucester Street, Sydney, on Friday, 22nd Febrauray, and a very representative gathering was in attendance. Quite a highlight of the evening was the manner in which Membership Secretary, Bill Dukes, 2WD, was "snowed under" with requests for Membership Forms. At the present, membership has never been higher, and this is in no small degree due to the very fine and able manner in which 2WD has carried out his work as Membership Secretary.

The evening was devoted to discussion on the forthcoming Federal Convention and Agenda items. Power was one of the main items discussed, and many and varied were the views expressed. One important topic was the present age limit of 18 years for the A.O.C.P, and the increase in code speed. The meeting, generally, was of the opinion that F.H.Q. had not taken a strong enough stand with the Department on these subjects. The Constitution was discussed and it was quite apparent that one speaker, Mr. John Moyle, VK2JU, had given the matter no little consideration. Unfortunately, space does not permit us to give any details, but a few more virile clear-thinking members like 2JU would do the Institute a lot of good.

On Monday, 25th February, a lecture was given by Mr. Frank Wood, B.Sc., Secretary of the Australian Radio Propagation Committee. The speaker chose for his subject, "The Ionosphere and its Effect on V.H.F. Communication." The lecture was well attended and the manner in which questions were asked at conclusion of the talk was ample evidence of the attention given the lecturer by the meeting. This lecture was an innovation and as such was highly successful, and members may look forward to other nights devoted entirely to some scientific topic.

Of course, the all important subject these days is DX, and with the present conditiosn prevailing on Ten, quite good hunting is to be had. The novelty of working the various Pacific Islands is fast wearing off. Nevertheless they were the means of quite a few of the boys working some new countries (we hope). The band is just alive with W.'s and K6's, presenting a splendid opportunity to obtain a 28 mc. W.A.S. A little bird told us that's what 2RA is going after in a quiet (?) sort of way! 2AHM with his low power is knocking them over and finding it very difficult to convince the Yanks that he's only using about 7 or 8 watts. 2AHP wants a European 2RA, a South American, and 2TI **half** a South American for W.A.C. Called CE1AH, but Ida—yes, she's still there —could not get the TI. Too bad.

Some of the DX heard and worked by the boys up here is VQ3TOM, ZS6DW, TG9BA, XE1FG, G5BJ, G6CJ, W9FSC/XZ, W6QJW/K7, VS5JH, VU2BG, VK4 LP/VK6 (Graham Moore Island), XU1YO. Who said Ten was no good?

2NO tells me that there is not a great deal of activity of Six as yet. VK2WJ, 2LS, 2ABZ, 2NO, and 2LZ are on quite a bit with 2LZ located at Wentworth Falls, putting in a very nice signal and as usual using something very "different." 2CP, 2AZ, 2EM, 2NP, and 2TI have been doing a bit of listening, and here's news. VK2NP has been heard on phone! Ahem! Well Chas. it's just about time you gave up talking with your fingers and became civilised.

March issue of the magazine was a remarkable one for the increase in size, and it must be gratifying to the Magazine Committee to know that it is now gaining the recognition it deserves by the Trade. But the Magazine must not be permitted to become an advertising medium only. An appeal is made to members of the VK2 Division for more Technical articles. During the war years is was reasonably easy to obtain articles, so much so that on more than one occasion the Magazine was an all VK2 issue. Surely there are many more subjects one can write about these days now that we are back on the air. How about an article on Antennas, preferably of the rotary type or for that matter any type of beam Antenna, for methinks you are going to be on ten for quite a long time yet. Again, how about a Receiver, designed particularly for 28 mc. and higher, or a Transmitter. Quite a few chaps are using Power Doublers with the usual sad results. What about it, chaps?

March issue of the Magazine was also an epic as we saw the passing of "Slouch Hats and Forage Caps," latterly known as "Hams on Service." Without a doubt this feature was more widely read than any other section of the magazine during the past six years, and this Division would like to thank 2YC for his efforts in providing a means of communication for hams on service, wherever they were, and I feel certain that Institute members who were on Service will join in saying "Thanks a lot, Jim."

The 36th Annual General Meeting of the Division previously set down for 25th January, will now take place on Friday, 26th April. This meeting will be held at

Scienec House, and will commence at 7.45 p.m. You are reminded that the Annual Election of Council will also take place on that date. Ballot Papers to be valid must be returned not later than noon of the day preceeding the Annual General Meeting. Also, when obtaining nominations, remember it is necessary to get the written consent of the nominee.

Don't forget on and after the March General Meeting, supper will be served at 10.15 p.m. Remember to wear your call sign.

A.O.C.P. CLASS.

After many set backs brought about by industrial trouble, lack of accommodation and departure of original Class Manager to another State, the VK2 A.O.C.P. Classes commenced on Monday night, 21st January, at the Rooms of the W.E.S.C., 10 Clarence Street, Sydney. This night marked a milestone in the history of the Wireless Institute of Australia in New South Wales. Not since 1929 has this Division had an A.O.C.P. Class.

The Institute was very fortunate in securing the services of Mr. Jack Howes, VK2ABS, as Class Manager. After serving five years with the R.A.A.F., and attaining the rank of Fl. Lt., 2ABS was only a civilian for about twenty-four hours,when he was "interviewed," and as a result, the Division gained the very man it had been looking for. 2ABS brings a wealth of technical and administrative ability with him and has proved himself a well-liked and popular instructor. He had been assisted by Neil Pieremont, 2NQ, and Mac Hicks, 2ADV.

The Classes are held in the rooms of the Women's Emergency Signal Corps, 10 Clarence Street, Sydney, an dthe Institute was particularly fortunate in obtaining accommodation here as we have an area all set up with every signalling device from blinker to Bendix transmitter. Here we certainly must not forget Mrs. F. V. MacKenzie and her band of helpers, who have had no little share in making the class a success.

Classes are held twice a week, Mondays and Wednesdays, commencing with Morse Practice at 6.45 p.m. and a lecture at 8 p.m. The Morse practice is divided into four groups depending upon the speed attained by the students. As time marches on, these groups are gradually reduced until there are only two—the fast and the very fast. Many students when commencing the Class had no knowledge of the code whatsoever, but soon began to make progress. At 8 p.m., the lecture begins and is usually given by the Class Manager, Mr. Jack Howes, and this concludes about 9.15 p.m.

Approximately thirty students will sit for the A.O.C.P. on 9th April, and opportunity is taken to wish them every success.

The next class will commence on Monday. 9th May, and it has been decided to extend the period of this class to five months, which will mean that Students will sit for the October A.O.C.P. Early application for enrolment is essential and all enquiries should be addressed to Class Manager, Box 1734, G.P.O. Sydney.

Applications are called for the position of Morse Instructors. These positions are not Honorary and any member interested may obtain particulars by ringing FF 1705.

Many thanks 2ABS for the fb job that you are doing.

VICTORIA

Secretary: R. A. C. Anderson, VK3WY,
Box 2611 W, G.P.O., Melbourne.
Meeting Place: Law Court Chambers, 191 Queen St.
Meeting Night: First Tuesday of each month.

The monthly meeting of this Division was held at the W.I.A. Rooms, 6th Floor, Law Courts Chambers, 191 Queen Street, Melbourne, on Tuesday, 5th March. Harry Kinnear, 3KN, was in the chair. This meeting broke all records for attendance, there being so many members

and visitors present that all could not be accommodated and the attendance book in being passed round was not available to many who missed out, entering their names to record presence.

There was a very entertaining demonstration of service transmitting and receiving gear, which took up most of the evening.

A special meeting of those interested in 200 Metre Band Transmissions is to take place at 8 p.m. on 6th April at the W.I.A. Rooms. This meeting is sponsored by the old 200 gang. All welcome.

Those present at the March meeting and who signed the attendance book are: GM4MV, 2AHY, 5FL, VK3's: KN, XD, WY, YJ, MJ, SK, ZS, UR, YF, XJ, ED, CT, DM, ZG, ZT, FR, SQ, UJ, LX, MN, IK, QE, EN, TE, ZC, XU, QC, KB, RI, FS, NW, JI, CO, HE, QU, IG, VX, RX, BQ, YP, KP, PG, HK, SB, AP, XG, QN, YH, XA, ET, HS, CF. TJ, ZJ, UM, NY, YL, KK, NU, JO, AG, OJ, FT, PW, NR, PO, CR, UK, BM, LN, UH, EE, DH, HX, OE, AFQ, AKL, AHY.

The following have submitted applications for membership:—R. L. West, W. A. McLeod, J. Qutty, J. K. K. Cosgriff, A. L. Wilson, 3JF, S. J. Wilcox, 3KS, F. Mills, E. Einsidel 3QE, J. D. Doyle, O. C. Benning, R. Morrison, H. J.Ashmus, 3ET, B. Slutzkin, 3SK, D. V. Hope, 3XA, D. A. Brooke, I. Sherer, G I. Morris, 3VZ, S. C. Broadbent, T. E. Paige

The following stations report strong activity on 6 MX: JD, MW, MJ, BQ.

The next meeting of this Division will be held at the Institue Rooms, 6th Floor, Law Courts Chambers, 191 Queen Street, Melbourne. on April 2, at 8 p.m. All welcome. To those intending to join, come along and do it.

QUEENSLAND

Secretary: H. MacGregor, VK4ZU,
"Mouquet," Eildon Road, Windsor, N.3.
Meeting Place: State Service Building, Elizabeth St., City.
Meeting Night: First Friday of each month.

A modest roll-up at the February General Meeting had the task of preparing agenda items for the forthcoming Federal Convention. One item that should meet with Australia-wide appeal is the proposal that in future QSL cards for WAC Certificates, etc., should be verified at F.H.Q., and so obviate the necessity of sending cards overseas with the ever-present possibility of loss in transit. Six other items were also tabulated.

A generous gesture was made by George Gray, 4JP, who offered to donate an 809 to the member responsible for the most new members during the next twelve months. Needless to say the offer was gratefully accepted.

As from the 12th March, our meeting place will be the State Service Building, Elizabeth Street, City, at the rear of Barry and Roberts. The situation is a much better one from the point of view of outside noise level, and the facilities for lectures, etc., are a big improvement on the Diggers' Association Rooms. The general meeting will in future be held on the first Friday in the month, and Student Classes will run on the 2nd, 3rd, 4th and sometimes 5th Tuesday in the month. Everyone please note the change of place and times.

A few of the local gang with their respective families had a day out at Redcliffe on Sunday, the 3rd of March. The weather was well-nigh perfect, and a good time was had by all. Owing to work I could not attend, but I believe that's the story.

I can't think of a better use for the remainder of our space than a brief account of the very FB reunion which was staged at Anzac House on the evening of Friday, the 8th. My memory is a little hazy as to the latter half of the evening, but I think the lines which follow give a pretty good outline of events. We had as our guests three members of the R.I.'s Dept., with Mr. Conry, the Senior R.I. of this State as head of the party. The Radio trade was well represented, both in the way of visitors and prizes donated for the numerous competitions held during the evening.

After the usual toast to the King, and a minutes silence for those hams who had pulled the big switch for the last time, we really settled down to have a good time, i.e., to drink, be merry, and eat. Running over the competitions, Fred Lubach proved to be the best judge of the number of peas in a bottle, the number being 1,270; 4RF's guess was only 40 short of that number.

For sheer honest-to-goodness ability to quaff a glass of beer, blow up a paper bag and burst same, we take our hats off to Arthur Burton, 4FE. It really seems a shame to see good ale disappear so quickly! Arthur later obliged with a turn on the piano, so the 809 and TCO/35, which he got for his effort, was well deserved.

Mr. Joe Foster, the well-known Albert Street Radio Dealer, voted the evening a great success. He didn't actually tell me this, but it was apparent that our friend enjoyed himself, which pleased us rather, for Mr. Foster has very kindly presented us with an Ellipsoid Microphone, to be presented to the beginner making the most progress in Morse during the first three months of his probationary period. If any of the new hams are finding the period of CW operation irksome, this should be some compensation.

Those DX merchants, 4EL and 4RF, found plenty to talk about during the evening, and we observe 4ES and 4AW using glasses for punctuation marks during their conversation. Frank, 4FL won a 5Z3 for something or other, although I don't know whether Frank knew just what sort of a tube it was at the time. I think it was a 5Z3, anyway! And then Vince Jeffs had to count up the number of correct answers to a Quiz we had, and which was too complicated a job for his next door neighbour. The simple addition of the answers I mean, of course.

Our treasurer, 4RC, worked his head and went around collecting the necessary contributions from every one while everyone was still sober enough to see that they weren't robbed. Our thanks, Bob. And then there was the little floor show which Tibby, 4HR, put on towards the end of the evening, or was it early morning? But our space is running out, so I'm afraid we will have to forget that one.

Before closing, I omitted to mention that at the conclusion of general business at our last G.M., we were treated to a lecture by Mr. Ellis on that most topical subject—"Radar." The lecturer obviously knew his sublect inside out, and it was a treat to listen to him.

Another small point. As Secretary, I shall very shortly be resigning, owing to business committments, but I hope these notes will continue to bear the signature, 4ZU.

SOUTH AUSTRALIA

Secretary: E. A. Barbier, VK5MD,
Box 1234 K, G.P.O., Adelaide.
Meeting Place: 17 Waymouth Street, Adelaide.
Meeting Night: Second Tuesday of each month.

The monthly General Meeting was held on Tuesday, 12th March. Again there was a record attendance. One wonders how long this sort of thing will continue. It was thought that last month's figures of 80 odd would take some beating. However, on this occasion a "Bradman" was scored, there being exactly 100 present.

In the absence of the President on holiday ,the chair was take nby the vice-president, Mr. Kilgariff, VK5JT, who introduced the lecturer, Mr. Reg. Davies, VK5LJ, whose subject was the very topical one of "Ten Metres." The lecturer was an enthusiast on 28 m.c. before the War and his talk, though mixed with theory, was of a very practical nature and was listened to with very close attention. Dealing with Receivers first, he acknowledged the advantages of Acorn tubes, but for those not in possession of this series, the 6K8 and 1852 were preferred as Mixers. As a seperate oscillator the 955, if available, and the 6J5 were recommended, with control grid injection to the mixer, whose fault is lack of sufficient oscillator power. This type of injection tends to aggavate "pulling" but the effect may be avoided by using a high I.F. frequency of the order of 3.5 m.c., which also reduces image interference. A good case was made out for the construction of a special 28 m.c. Converter to be fed into the ordinary short wave super, which would be tuned to 3.5 m.c. to act as the I.F. amp., etc. This scheme would help the designer in keeping leads very short, the necessity for which was stressed. Each "return" should be to the cathode itself and by **separate** and **single** paths. The cathode circuit can cause a big loss and battery bias instead of the usual cathode resistor effects a big improvement. A good R.F. stage, free from regeneration, is highly desirable. Regarding the Transmitter, the lecturer said that high power was not needed. The main trouble usually experienced was in neutralizing the final and a useful tip given that, in addition to the usual grid-plate neutralizing, the plate-filament capacity also be neutralized. Earthing one side of the filament was considered better than the filament centre tap method. The antenna is more important than transmitter power in working d.x. The usual 66 feet flat top aerial is not good enough; some form of directional antenna is needed and of these the "Lazy H" is perhaps the pick. Arrays with director and reflector are apt to be critical in tuning and not suitable for covering the entire band.

The vote of thanks to the lecturer was proposed by Mr. Cook, VK5AC, and caried with acclamation.

It was with very deep regret that members learned of the passing of Alwyn Reimann, VK5JO, after a short illness. He was a member of the Institute from 1928, worked on low power on the old 32 metre band, and was prominent in interstate 80 metre contests; was one of the first to instal crystal control, ground his own crystals and made them **work.** He took a prominent part in Institute affairs and held many of its offices (Chairman B.P.S., Asst. Secretary, Council member, etc.). His funeral was attended by Directors and fellow-workmates of Harris Scarfe Ltd., and representatives of other firms and broadcasting stations. The W.I.A. was represented by Messrs. Barbier, Brown, Kilgariff, Luxon and Whitburn. At the meeting, members stood in silence for two minutes as a tribute to his memory.

The Q.S.L. Officer, Mr. Geo. Luxon, VK5RX, advises that the Q.S.L. service is again in operation, and he is "open for business"—at ½d. a card.

It was announced that Mr. F. D. Askins(late of the R.A.A.F. Signals Training School) would be the lecturer

in Theory for the next series of Student Classes, due to commence on 16th April. There will be approximately 20 weekly lectures.

During the past month 19 new members have been enrolled. They are Messrs. H. L. Austin, E. L. Beck, R. G. Bishop, A. E. Brown, G. S. Coombe, L. E. Coombe, L. H. Duncan, D. E. Hosking, T. C. Hosking, W. A. S. Jolly, R. T. Manuel, R. T. Mills, J. W. Pitcher, A. J. Ross, R. G. Scott, J. P. Sullivan, A. W. Taylor, L. W. Wallbridge, and C. R. Williams. A hearty welcome is extended to each and all. Total membership is now 176.

At the next General Meeting to be held at 17 Waymouth Street, on Tuesday, 9th April, Mr. John Allan will give a talk on "Radar."

WESTERN AUSTRALIA

Secretary: H. B. Lang, VK6HL,
Box N 1002, G.P.O., Perth.

On January 21 a general meeting of the Division was held, and at that meeting a new Council was appointed consisting of:—Messrs. C. Brown, VK6CB; W. Schofield, VK6WS; H. Lang, VK6HL; W. Peterson, VK6LW; E. Doddy, VK6WH; F. Lambert, VK6FL; C. Moss, VK6GM; J. Morris, VK6TX, and R. Hugo, VK6KW.

From this Council the executive officers were elected and are: President, Mr. G. A. Moss, VK6GM; vice-president, Mr. W. Schofield, VK6WS; Secretary, Mr. H. B. Lang, VK6HL; and Treasurer, Mr. F. Lambert, VK6FL.

At the meeting it was unanimously agreed that the annual subscription be raised to £1/1/-, this subscription to include "Amateur Radio." It was further agreed that after frequent meetings with the executives of the local radio clubs, the Division accept as members, only the holders of the A.O.C.P. or higher qualifications. By this move it is hoped to enroll all VK6 amateurs as members, and in consequence the Division will then be able to devote all its attention to the requirements of the active experimenter.

TASMANIA

Secretary: J. Brown, VK7BJ,
12 Thirza Street, Newtown.
Meeting Place: Photographic Society's Rooms, Liverpool Street, Hobart.
Meeting Night: First Wednesday of each month.

At the monthly meeting held at the usual quarters, Liverpool Street on the 6th of March, the attendance was good, present being VK7LJ in the chair; VK7BJ, VK7LL, VK7ML, VK7AH, VK7CL, VK7CT, VK7AL, VK7GJ; Messrs. A. Morrisby, F. Gee, — Neilson, — Koglin, and Les Reardon. Apologies were received from VK7CW, VK7PA, VK7CJ, VK7RV, and A. Russell, ex-VK5AR.

Council business was attended to immediately before the general meeting.

Correspondence from the CSIR re charts on Frequency Prediction, etc., was received, and the secretary, VK7BJ, said that the 28 Mc predictions for February were correct in Tasmania.

Seven new members were proposed and accepted, these constituted four full and three associate members.

The outcome of the decision at the last meeting in connection of the procuring of a P.O. Box was the report that the Division could be placed on a "waiting list" with 60 others.

Kelly, VK7LL, and Conway, VK7CL, were elected as a sub-committee to interview the Forestry Department and the Hobart Fire Brigade re assistance in case of bush fire and other emergencies.

No details of Convention agenda items from the other States have, as yet, been received, and so far no VK7 delegates is forthcoming, but high hopes are held.

A Jap. Frequency Meter was presented by Mr. R. A. Anderson for the use of members of this Division, and a hearty vote of thanks was tendered Mr. Anderson for his gift.

VK7BJ's scheduled lecture on Frequency Modulation went off very well, and many of the technicalities must be better understood by all not too conversant with its application. The Council's action to provide one of these lectures or talks at each meeting is to be comended, and all members are asked to co-operate to their fullest extent; Joe's effort met with heartly acclamation.

It was very pleasing to see our G.O.M., VK7AH, again present, his health has been playing up a bit lately, and his enthusiasm at 78 is to be commended, not to mention his vitality.

H.M.A. Ships "Shropshire" and "Bataan" visited Hobart during February, and P.O. Syd Clark, of the "Shropshire's' Radio Section, was entertained on several occasions, one of which constituted an evening "Around the shacks with the VK7's" and wound up at 7LJ's with an exhibition of movies in colour of some of Tasmania's beauty spots, and then supper graciously provided by Mrs. LJ, and greatly appreciated by those present.

Syd is a prospective VK2 awaiting his licence, having recently taken the "A" class exam. On his visit he was accompanied by another shipmate. By the way, Syd, congratulations on the new arrivals, let's hope there will be a boy next time.

It was regretted that other Hams from the Bataan were not able to be present as was intended.
VK7CW reports that the 28 Mc band "opened up" on Sunday, 3rd of March. He says that thousands of Yanks were heard like locals and were working a contest.

VK7AL is another about ready for the air and has been concentrating on making a super perk properly on the 28 Mc band.

The picnic scheduled for Sunday, 24th February, was conducted in perfect weather, and the time available to many was all too short. Amongst those present were: VK7's—LJ, BJ, CW, CT, CL, WR, ML, CJ, AL, PA, and Bert Russell, ex-5AR, all accompanied by their families and/or friends, and a most enjoyable time was had, all voted it to have been FB.

Some of the earlier arrivals were by boat, and when the later arrivals turned up they were found diligently baling a cavity in the rocky part of the beach and catching fish trapped therein—some a full four inches long—and they were last seen swimming in a beach bucket full of salt water—yes—the fish, of course. Imagine seeing BJ or CL in a beach bucket!

Water was boiled and lunch partaken of and then some of the gang engaged in a spot of cricket, while others enjoyed a dip in the briny. Many, particularly the womenfolk, just sat in the sunshine and did the usual!—no offence—as Hams can't talk—never learned to, Hi. As usual when Hams gather, the talk always gets around to receivers, transmitters, service disposals antennas and the like.

A couple of very ambitious Hams sallied forth complete with lines, etc., in hopes of excelling the previous catch—those in the pool— and 7ML was seen about 3 p.m. landing a nice-sized rock cod, which was greeted with much applause, in fact, for a moment it sounded like some popular favourite romping home. Bert, fisherman No. 2, was looking very dejected at one stage when he was perched on a rocky spit almost water encircled with only the flies to annoy him.

To recount the many varied scnes and happenings of the day would almost fill up the magazine, so I'll just end the notes by reminding you that the General Meeting is always held on the first Wednesday of each month at the Photographic Society's Rooms, Liverpool Street, Hobart.

Frequency Modulation

(Continued from page 4)

this case not much reduction of noise can be expected. Generally speaking FM is not suitable for long distance involving ionospheric transmission.

Whilst FM owing owing to its suppression of interference from other Ham stations (FM, AM and CW) and its reduction of noise should be very attractive to the Ham who is prepared for the complexity and expense involved, it is likely that some Hams may consider its greatest advantage to be that, until FM BCL sets become common the BCL will not be able to track down Ham interference.

In the second talk I will be dealing with the equipment and circuits necessary to produce, radiate and reproduce FM signals.

Plastics

(Continued from page 9)

the top. Owing to the rather brittle nature of "Distrene" only light cuts should be taken in order to avoid chipping. It is important to note that for machining purposes "Distrene" rods and sheets require to be SUPPLIED IN A "STAIN FREE" CONDITION to avoid cracking.

When threading and tapping the chief point to be observed is that the principle of variation of rake with softness of material holds. The softer the material the greater should be the backing-off of a cutting edge. In general, pitches should be coarse and threads not too sharp.

Aagin home-made cement can be made by dissolving flaked "Distrene" in benzene. The writer has found this a very useful H.F. varnish which can be used on H.F. coils without causing any noticeable loss. Several samples were measured at 60 Mc/s using a standard commercial "Q" Metre, and while other cements caused a noticeable change in "Q" none was noticed with this varnish.

ALKATHENE

"Alkathene" or Polyethyline, being a softer material, is comparatively easy to handle, although the manufactureres state that a harder material known as Grade 2 is now available. Unfortunately, the writer was not supplied with a sample, so no information can be supplied.

It is important to note that heating must be carried out with great care. The material becomes soft at 115 degrees C., and can be shaped easily, bu this temperature should not exceed 120 degrees C. in air. Decomposition occurs about this temperature and increases as the temperature is increased. The rate of oxidization is also dependent on the ease of access of air. Not only does this oxidization give rise to an increase of the power factor, but the material becomes stiffer, and after a time "sets up." The time of heating should be kept down, and the lowest possible temperature used.

The writer endeavoured to make an "Alkathene" cement by dissolving small pieces of the material in hot carbon tetrachloride. The varnish so obtained was not, however, satisfaltory as it held no adhesive properties, and therefore cannot be recommended.

The writer acknowledges his indebtedness to Mr. E. C. Couzens for permission to utilize information con- Industry" (Electronic Eng., price 2/6); and to Messrs. tained in his monograph entitled "Plastics in the Radio I.C./. Ltd. and B.X. Plastics, for additional information.

QUARTZ CRYSTALS

Radio communication might have been impaired and the work of producing quartz crystals materially increased had not an accidental fracture of a crystal revealed the usefulness of small siz e crystals. A South African amateur, after dropping his precious "rock" reported his accident to the American crystal manufacturer when ordering a replacement, stating that his crystal was now in tiny fragments which still worked!

From this chance remark grew the design changes that produced millions of military crystals at an enormous saving in quartz and expense. The former one-inch square crystals were replaced by tiny bits of quartz averaging less than three-tenths of a square inch in area. The thickness of the new crystals runs from fifteen to eighteen thousandths of an inch. Reduction in crystal size resulted in the production of more plates per pound of raw quartz and also in the use of quartz of a size and quality formerly considered non-adaptable to radio use. The saving in quartz is estimated at 1200 tons.

—Q.S.T.

TIME SIGNALS

Several systems of signalling time, controlled by the local observatory, are in use. Most commony used are Onogo, Modified Onogo, U.S. New System and Modified Rhythmic. (Incidentally, Sydney has a system all its own.)

Onogo and Modified Onogo are similar, the transmission being as fololws:—

1st Minute: A series of the letter X sent every five seconds from 0 to 49 seconds, six seconds silence, followed by the letter O (- - -) each dash being of one second's duration commencing at 55th, 57th and 59th second.

2nd Minute: A series of the letter N sent once every 10 seconds . . . the dot being made at the tenth second: five seconds silence followed by the letter O as in the first minute.

3rd Minute: A series of the letter G sent once every 10 seconds . . . the dot being made on the tenth seconds.

In the modified Onogo system six dots are substituted for the three dashes of the letter O. The dots are made at 55th, 57th, 58th, 59th and 60th seconds of each minute.

U.S. New System is made over a period of five minutes and incorporates a feature which makes possible the identification of each minute. This feature is particularly handy when copying through QRM or QRN.

The signals commence 5 minutes before the hour and an examination of the diagram will make the system quite clear.

Mins.	Seconds										
	50	51	52	53	54	55	56	57	58	59	60
55	—		—	—	—	—					—
56	—	—		—	—	—					—
57	—	—	—		—	—					—
58	—	—	—	—		—					—
59	—										—

Time Signal

The writer has had nothing to do with the Modified Rhythmic System so a brief outline only, will be given of this method.

It is very accurate and is generally used only for survey purposes where the high degree, point O1 second accuracy is required

Three hundred and six signals are emitted in three hundred seconds of mean time, the concluding signal being the exact minute

In each series, signals No. 1, 62, 123, 184 245 and 306 are single dashes of point 4 second duration and commence at the exact minute. Each dash is followed by 60 dots of point one second duration.

Checking the chronomter: Count the number of intervals from the first dash until coincidence occurs between one of the rhythmic signals and the beat of the chronomter (with the chronomter beating ½ seconds there are two such coincidences 29½ and 30½ seconds apart every minute.

It is not neceassary to actually count the signals.

Write down:—

(1) The chronometer time of the tick (whole or half second) immediately preceding the first dash.

(2) The chronometer time of coincidences (seconds only need be written down).

The difference between (the elapsed time) increased by point 5 second when it is not a whole number gives the rhythmic interval number from which the correction can be obtained on the chart.

—From Admiralty List of Signals.

FOR SALE, EXCHANGE, WANTED

9d. per line, minimum 2/-.

FOR SALE.—8 tube super; 1, TRF, Separate HF Osc., Coils for all bands to 28 Mc.; Xtal filter, 3 position selectivity ,2 stages of I.F., CW Osc., Penthode output, noise limiter, speaker. Really works on 28 Mc. Price £33. Ring WL 2614—VK3CP.

9 tube commercial communications receiver; also assorted transformers for exchange or sale. Phone Win. 3104—VK3SK—Handle "Bob."

AMATEURS NOTE:—Ex Ham disposing of equipment. Power supplies Crystal Oscillator, Keys, Valves, Condensers, odds and ends. Ring U 2135, or call 1256 High Street, Malvern.

FOR SALE—A large quantity of miscellaneous radio equipment belonging to the late Norman Gunther, VK3 NG. Information may be had from Bright Star Radio, 1839 Lower Malvern Road, Glen Iris. Phone UL 5510, where catalogues may be inspected.